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PROPERTIES OF ALUMINIUM MESH REINFORCED POLYESTERCOMPOSITES

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ABSTRACT

This project deals with the study of physical, mechanical and chemical resistance properties of aluminum mesh reinforced polyester based blend composites with different forms of blending on weight percentage and reinforcement in layered form like single layer and double layer etc., and with the blending resin characteristics and different blending proportionalities. The efficient mechanism preserved the structural integrity of the composite under impact loads. The findings will support the development of a generic quasi-static analytical model and numerical methods for further valuations

Key words: Niche Applications, Blends, Degrees of Freedom, Structural Integrity

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1. INTRODUCTION

Over the last thirty years composite materials, plastics and ceramics have been the dominant emerging materials. The volume and number of applications of composite materials have grown steadily, penetrating and conquering new markets relentlessly. Modern composite materials constitute a significant proportion of the engineered materials market ranging from everyday products to sophisticated niche applications. While composites have already proven their worth as weight-saving materials, the current challenge is to add additional degrees of freedom which provide potential versatility to the present composites by blending of different polymers

This project deals with the study of physical, mechanical and chemical resistance properties of aluminum mesh reinforced polyester based blend composites with different forms of blending on weight percentage and reinforcement in layered form like single layer and double layer etc., and with the blending resin characteristics and different blending proportionalities. The efficient mechanism preserved the structural

integrity of the composite under impact loads. The findings will support the development of a generic quasi-static analytical model and numerical methods for further valuations

2. MATERIALS AND METHODS

Polyester Resin

Catalyst (methyl ethyl ketone peroxide)

Accelerator (cobalt naphthenate)

Aluminium mesh (as reinforcement)

Treated C.N.S.L (to blend)

Untreated C.N.S.L (to blend)

2.1. Reinforcement Material

Aluminium Mesh: The aluminium mesh of the desird diameter is taken and cut that role in to the desired dimensions and roll it to make the mesh straight with out having any flaws in the planelyness of the mesh.

Fig. 2.1.a. Marking on aluminium mesh

Fig.2.1.b. Cutted aluminium mesh

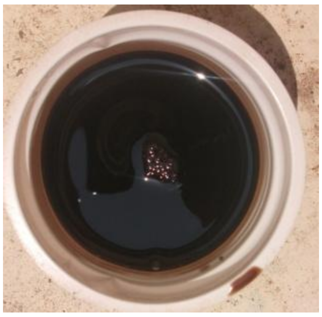


Fig.2.1.c Un-Treated CNSL Sample

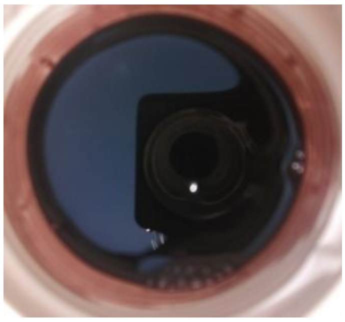


Fig. 2.1.d Treated CNSL

Figure 2.1 CNSL Samples

2.2. Mould Details

For tensile test samples preparation, we have used Aluminium mould of size 280mm in length, 27.5mm in width and 10mm in thickness (280mm x 27.5mm x 10mm) as shown in below figures. Grease is applied in the mould cavity for easy stripping of the composite specimen.

Figure 2.2.a Aluminium Moulds

Figure 2.2.b Aluminium Mould

2.3. Samples Preparation

Hand layup method is adopted to fill the prepared mould. First we have to take the required quantity of resin, catalyst and accelerator and other fibre materials. First resin is poured into the mixing beaker and then catalyst is added to the resin and then mixed thoroughly with stir rod. then added accelerator to the above mixture and after mixing thoroughly and before solidification it is then poured in the Aluminium mould. After 24 hours remove specimens slowly, and then repeat the procedure by changing the Percentage of reinforcement as 0% i.e, 0 layer of the matrix.

In order to prepare the composites with reinforcement

- First the matrix material was poured slowly into the mould to avoid trapping of air. The mixture was left for 2 min. until it become little tacky.
- Then aluminium mesh layer was laid unidirectionally on the matrix layer which was covered by another layer of matrix material. such that we can get the polyester-ALmesh – polyester composite. The setup was cured under the loaded condition of 25 kg for about 24 hours.
- In the same way for double mesh reinforcement add another mesh to the above procedure such that we can get the polyester-ALmesh – polyester-AL mesh-polyester composite. The setup was cured under the loaded condition of 25 kg for about 24 hours.

2.4. Preparation of the blended composite

The preparation of the blended composite is similar to the above mentioned method but the variation comes at the preparation of the matrix material. before mixing the accelerator and catalyst to the resin add 5% weight proportion of the either treated or untreated C.N.S.L and fallow the hand layup procedure for the different types of reinforcements.

The composite samples were prepared in three different types of reinforcements i.e, 1 layer, 2layer, 0layer.This is done while keeping the Polyester resin content at a fixed percentage. In the same way the three different reinforcements was done for the blended resin with (5% wt) treated and (5% wt) untreated C.N.S.L.

The detailed composition and designation of composites are shown in below table 1.

Table 1 Designation of Composite Test Specimen Samples

Test Specimen	Compositions
TS1	Polyester Resin + 0% Reinforcement
TS2	Polyester Resin + 1 layer of aluminium mesh
TS3	Polyester Resin + 2 layers of aluminium mesh
TS4	Polyester Resin + 5% of treated C.N.S.L
TS5	Polyester Resin + 5% of treated C.N.S.L +1 layer of aluminium mesh
TS6	Polyester Resin+5% of treated C.N.S.L +2 layer of aluminium mesh
TS7	Polyester Resin + 5% of untreated C.N.S.L
TS8	Polyester Resin + 5% of untreated C.N.S.L +1 layer of aluminium mesh
TS9	Polyester Resin + 5% of untreated C.N.S.L +2 layers of aluminium mesh

3. RESULTS AND DISCUSSIONS

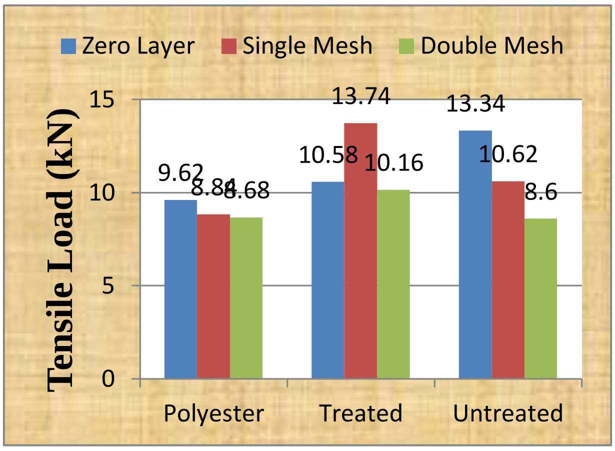
3.1. Effect of reinforcing on tensile properties of the composite

We can observe the variations of the different tensile properties of the composites with different reinforcements and blends.

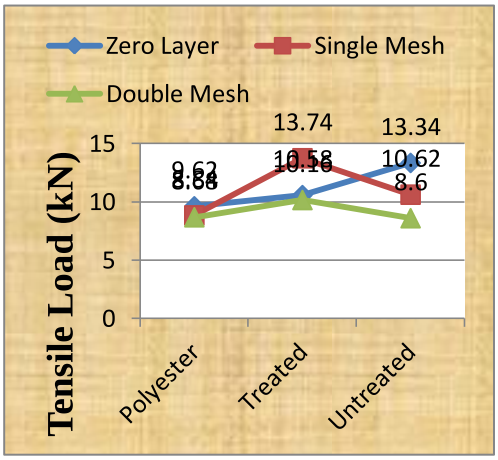
This graphs indicates that the maximum tensile load was beared i.e, 13.74KN by the specimen 5. And the tensile property of the blended composites was increasing from polyester to treated and fallowed by untreated.

The graphs shows that the tensile stress was so poor for all double mesh reinforced composites and the single mesh reinforced composites have maximum values i.e, 52, 45 the double mesh composites have less tesile strnth because of more elongation.

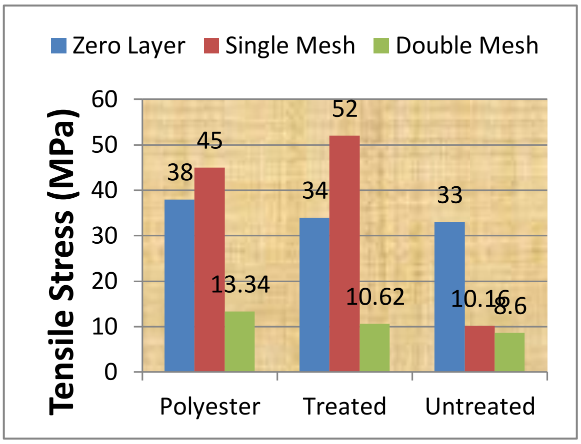
As the tensile modulus is based on the elastic nature of the materials, the tensile modulus is greater for the double mesh reinforced composites because of more elongation in all types of blends.



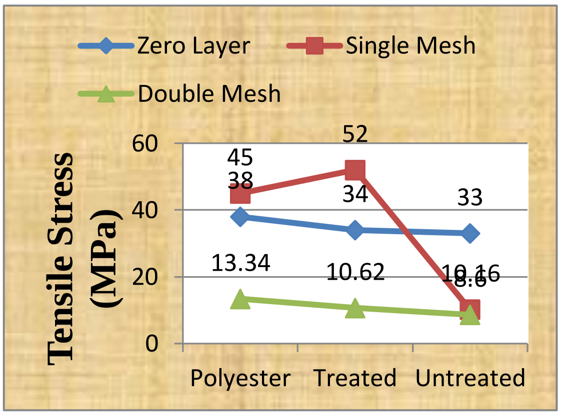
Graph. 3.1.a. Effect of blending on the tensile load of the composite



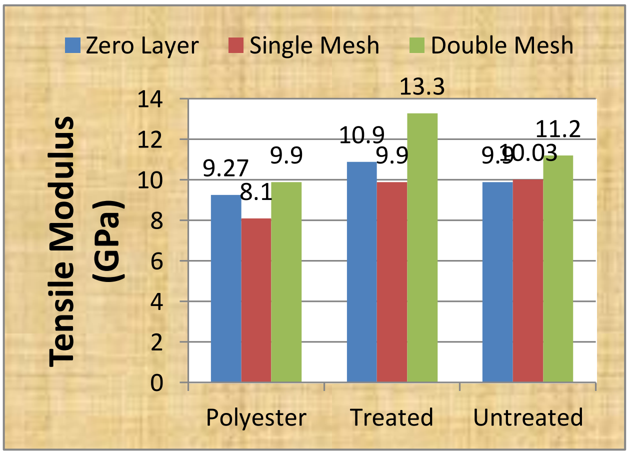
Graph. 3.1.b. Effect of reinforcement on the tensile load of the composite



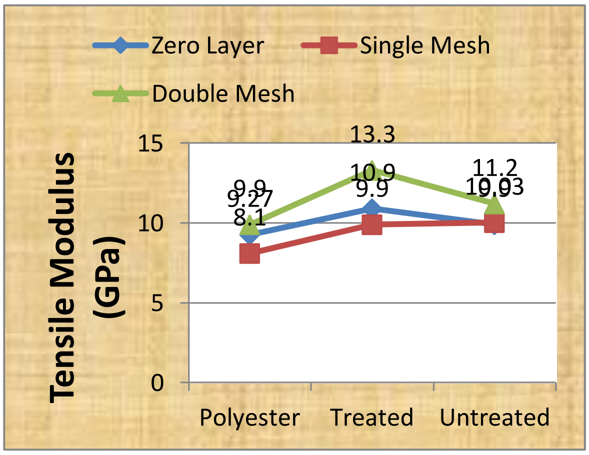
Graph. 3.1.c. Effect of blending on the tensile stress of the composite



Graph. 3.1.d. Effect of reinforcement on the tensile load of the composite



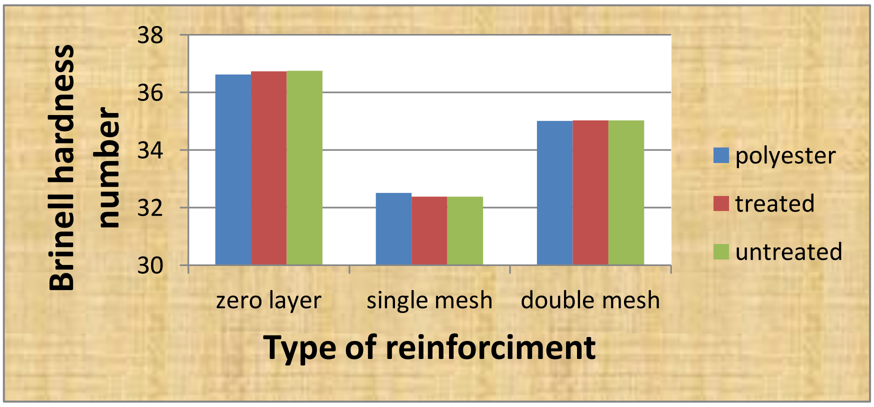
Graph. 3.1.e. Effect of blending on the tensile modulus of the composite



Graph. 3.1.f. Effect of reinforcement on the tensile load of the composite

3.2. Effect of fibre loading on Hardness of Composites

Surface hardness of the composites is considered as one of the most important factors that govern the wear resistance of the composites.



Graph 3.2.a Effect of reinforcement on the hardness of the composite

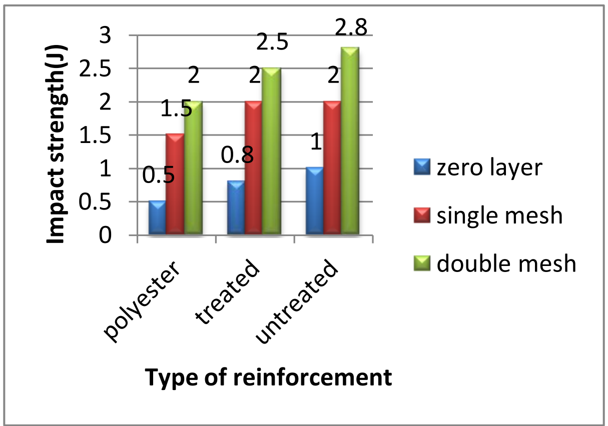
The hardness of the composite varies rarely by reinforcement as the reinforcement is mesh which have a micro effect on the surface property of the material as it was totally covered by the matrix material so the reinforcement does not plays a major role

in the hardness of the composite but the blends shows different hardness characteristics. but the results shows that the pure polyester has more harder than the blended composites.

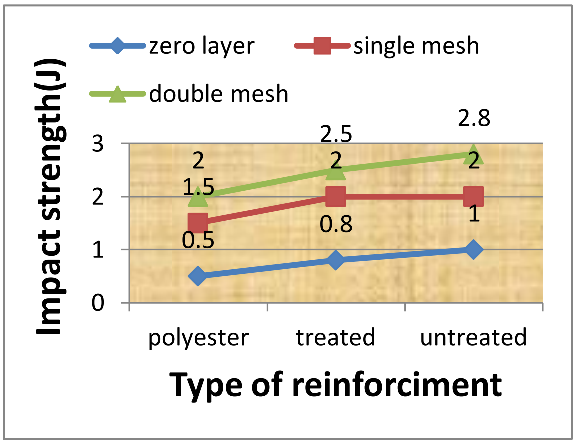
3.3. Effect of reinforcement and blending on Impact Strength of Composites

Graph 4.4 shows the variation of the impact strength of blended and polyester composites with and without reinforcement. It is found that the impact strength of composites linearly increased as the reinforcement is increased. This is due to excellent dispersion of reinforcement and effective stress transfer between the mesh and the matrix.

The impact strength of the composite is based on the reinforcement .the impacet load is distributed on the composite until the last layer of the reinforcement will fails so the impact strength will be more for the double mesh reinforced composites.



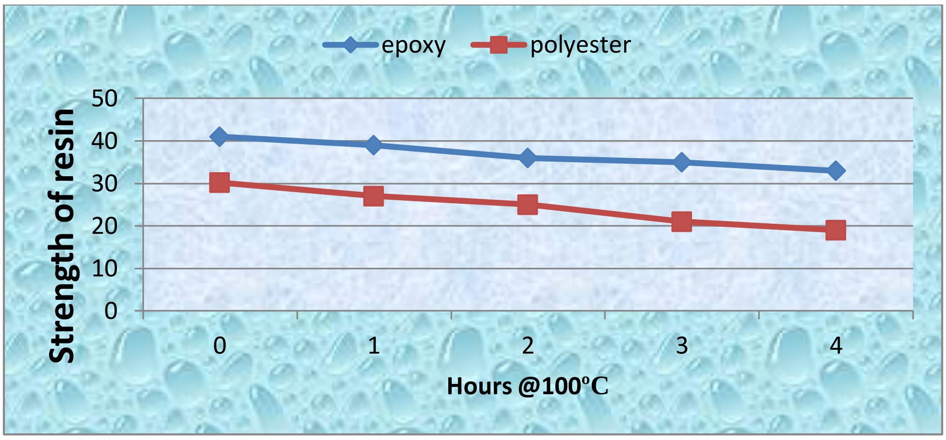
Graph. 3.3.a Effect of reinforcement on the impact strength of the composite



Graph. 3.3.b. Effect of blending on the impact strength of the composite

3.4. Degradation from Water Ingress

An important property of any resin, particularly in a marine environment, is its ability to withstand degradation from water ingress. All resins will absorb some moisture, adding to its original weight, but what is more significant is how the absorbed water affects the resin and resin/fibre bond in a composite, leading to a gradual and long term loss in mechanical properties. Both polyester and vinyl ester resins are prone to water degradation due to the presence of hydrolysable ester groups in their molecular structures. As a result, a thin polyester material can be expected to retain only 65% of its bonding strength after immersion in water for a period of one year, whereas an epoxy laminate immersed for the same period will retain around 90%.



Graph 3.4.a Demonstrates the effects of water on an epoxy and polyester woven glass laminate, which have been subjected to a water soak at 100°C. This elevated temperature soaking gives accelerated degradation properties for the immersed composite.

3.5. Chemical Resistance Test

The chemical tests were conducted for all polyester, untreated & treated mesh reinforced matrix blend composites. The effect of some acids, alkalis and solvents that is acetic acid, nitric acid, hydrochloric acid, sodium hydroxide, sodium carbonate, ammonium hydroxide, benzene, toluene, carbon tetrachloride and distilled water on untreated & treated fibers reinforced composites was studied [9]. In each case the specimens were first pre weighed in a precision electrical balance and dipped in chemicals for 24 hours. Then they were removed immediately washed with distilled water and dried by pressing on both sides with a filter paper at room temperature. Table 4.6a shows % weight loss or % weight gain values of untreated & treated blend composites immersed in acids, alkalis and solvents. It was clearly evident that weight gain was observed for almost all the chemical reagents except toluene and carbon tetrachloride. It is also observed from the table that treated composites also have weight loss in carbon tetrachloride [23, 24]. The reason was attack of the chlorinated hydrocarbons on the cross linked polyester system. The positive values indicate that the composites were swollen with the gel formation rather than dissolving in chemical reagents [26]. It was also observed that composites were also resistant to water. This study epitome clearly that mesh reinforced matrix blend composites are substantially resistant to almost all the chemicals except toluene and carbon tetrachloride. Therefore observations suggest that these reinforced blend bio-composites can be used in automobile & transportation applications.

Table 3.5.a Effect of chemicals on the weight of untreated and treated blend composite

S.No	Chemicals	Weight loss(-)or gain in %		
		Untreated composite	Treated composite	Polyester composite
1	8 % Acetic acid	12.7	12.9	3
2	40 % Nitric acid	13.2	13.4	3.8
4	Carbon tetrachloride	-0.71	-0.55	1
5	Benzene	2.0	1.86	-
6	Toluene	-1.21	-0.91	0.97

3.6. Deflection test

The deflection test is conducted on the treated single mesh reinforced composite beam in order to determine the composite for transverse loading. The composite beam is simply supported at two ends and the load was applied at the centre of the beam and the deflections were taken at the 1/4th length of the beam from support by placing Dial gauge at the respective point. The values of deflection were tabulated on the table no 4.7a

Table 3.6.a Deflection of composite beam under loading

Load (in kg)	Deflection (in mm)		Deflection	Young's modulus(N/mm2)
	Loading	Unloading		
0.5 kg	1.98	1.97	1.975	6.995*103
1kg	2.50	2.49	2.495	6.940*103
1.5 kg	3.45	3.44	3.445	6.994*103
2kg	5.68	5.68	5.68	6.997*103

The young's modulus of the composite beam is (E) = 6.9815*103

4. CONCLUSION

The experimental study on the effect of physical, mechanical and water Ingress behaviour of polyester based mesh reinforced and blended composites leads to the following conclusions:

1. The successful fabrication of a new class of polyester based blended composites reinforced with aluminium mesh have been done. The present investigation revealed that reinforcing and blending significantly influences the different properties of composites. The maximum tensile load 13.74 kN is obtained for composites Polyester Resin + 5% of treated C.N.S.L +1 layer of aluminium mesh, however the maximum tensile stress 52 MPa and tensile modulus 13.2GPa are obtained for composites made of Polyester Resin+5% of treated C.N.S.L +2 layer of aluminium mesh.
2. The maximum hardness 36.7525 BHN is obtained for Polyester Resin + 5% of untrated C.N.S.L blend composite.
3. The maximum impact strength 2.8 joules is obtained for composites having reinforced with Polyester Resin + 5% of untreated C.N.S.L +2 layers of aluminium mesh.
4. The Degradation from Water Ingress for a thin polyester material can be expected to retain only 65% of its bonding strength after immersion in water for a period of one year.
5. Possible use of these composites such as mesh reinforced transparent green house coverings for gardens, laminates for marine applications etc. The blended composites can be used at the applications where the flexibility of the material is requiredespecially from the study the Polyester Resin + 5% of treated C.N.S.L+1 layer of aluminium mesh composite has a great mechanical properties for the majour applications in the automobile sectors. However, this study can be further extended in future to new types of composites using other potential and the resulting experimental findings can be similarly analyzed.

4.1. Scope for future work

There is a wide scope for future scholars to explore this area of research. The present work can be further extended to study other aspects of composites like use of different composition of blend and reinforcement or by varying the reinforcement material for the blends may enhance or vary the different properties.

Can also vary the properties by adding some fillers in order to enhance the thermal, electrical conductivity, Stiffness, protection against UV radiation, bonding strength etc,

REFERENCES

[1] Harani, H., Fellahi, S. and Bakar, M., Toughening of epoxy resin using hydroxyl-terminated polyester, *Journal of Applied Polymer Science, 71,29-38 (1999)*

[2] A text book of material science by vv. Ragavaan

[3] Optimization of Blended Composite Wing Panels Using Smeared Stiffness Technique and Lamination Parameters Dianzi Liu* and Vassili V. Toropov† *Universityof Leeds, LS2 9JT, UK* Ming Zhou‡ *Altair Engineering Inc., 2445McCabe Way, Suite 100, Irvine, CA 92614, USA and* David C. Barton§ andOsvaldo M. Querin** *University of Leeds, LS2 9JT, UK.*

[4] Definitions of terms related to polymer blends, composites, and multiphase polymeric materials w. j. work1,‡, k. horie2, m. hess3, and r. f. t. stepto4 288 Burnett Road, Huntingdon Valley, PA 19006, USA; 26-11-21, Kozukayama, Tarumi-ku, Kobe655-0002, Japan; 3Universitat Duisburg-Essen, Fachbereich 6: Physikalische Chemie, D-47048Duisburg, Germany; 4University of Manchester and UMIST, Polymer Science and Technology Group(MMSC), Grosvenor Street, Manchester, M1 7HS, UK Pure Appl. Chem., Vol. 76, No. 11, pp. 1985–2007, 2004.

[5] Vinod B and Dr Sudev L J. Effect of Fiber Length on The Mechanical Properties of Palf Reinforced Bisphenol Composites, *International Journal of Mechanical Engineering and Technology*, 5(9), 2014, pp. 232-238.

[6] Prof. Dr. Matani A.G, Prof. Deulgaonkar V.R and Prof. Dr. Kallurkar S.P. AN Investigation of Structural Integrity of Chassis Mounted Platform Subjected To Concentrated Load During Braking, *International Journal of Mechanical Engineering and Technology*, 4(1), 2013, pp. 115 - 122.

[7] A. A. Shaikh and S.A. Channiwala. To study characteristic of jute polyester composite for randomly distributed fiber reinforcement, Proceedings of World Congress Engineering 2010 vol. II, London, U.K.